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CONTENTS

The Brooklyn Botanic Garden:—

The Social, Educational and Scientific Value of Botanic Gardens: PROFESSOR JOHN MERLE COULTER 643

Ideals and Opportunities for a Botanic Garden: DR. C. STUART GAGER 648

The Scientific Work of the Bureau of Fisheries: DR. H. M. SMITH 653

Scientific Events:—

Concerning the Manufacture of Phthalic Acid and Phthalic Anhydride; The Crocker Land Expedition; Applied Psychology at the Carnegie Institute of Technology 654

Scientific Notes and News 656

University and Educational News 659

Discussion and Correspondence:—

Heritage and Habitus: DR. HENRY FAIRFIELD OSBORN. *Scientific Meetings in War Times:* COLIN G. FINK 660

The Proceedings of the National Academy of Sciences: PROFESSOR EDWIN BIDWELL WILSON 661

The Decimal Point: PROFESSOR LOUIS C. KARPINSKI 663

The Shortage of Platinum 665

Special Articles:—

Is the House of Tcuhu the Minoan Labyrinth? PROFESSOR HAROLD SELLERS COLTON. 667

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THE SOCIAL, EDUCATIONAL, AND SCIENTIFIC VALUE OF BOTANIC GARDENS[1]

IT is a noteworthy fact that the United States is beginning to appreciate botanic gardens. This appreciation may be relatively superficial as yet, but the superficial is usually the preliminary step that leads to the fundamental. The desirability of botanic gardens was not obvious when large areas in a state of nature were available to almost every one; but when we developed congested populations in cities and made artificial most of our open areas, the thought of botanic gardens began to take form.

Those of you who have traveled in Europe must have been impressed by the multiplicity of such gardens. They began there in the form of monastic gardens, in which the so-called "simples," used in primitive medicine, were cultivated. Then they came out into the open as city gardens, chiefly for the enjoyment of the people and to beautify the city. Finally, they became also scientific, and gradually led to such great establishments as the botanic gardens at Rome, Geneva, and Paris, the great modern gardens on the outskirts of Berlin and Munich, and that greatest of all garden establishments, the Kew Gardens of London. These are but conspicuous illustrations of what almost every European city had developed before we began to think of garden establishments.

I wish to speak of three conspicuous con-

[1] Address delivered at the dedication of the laboratory building and plant houses of the Brooklyn Botanic Garden, April 19, 1917.

tributions that such an establishment can make, not all of which are appreciated as they should be. There is no better audience for this purpose than the friends and supporters of the Brooklyn Botanic Garden, which has achieved more in certain directions than any other garden in the country. I wish you to realize, not only that your support is justified, but also that perhaps you have builded better than you knew. I shall speak of these three contributions in what I conceive to be the inverse order of their importance, in the sense that the superficial, however desirable, is less important than the fundamental.

1. The first is the *social* contribution. "Social" is a very inclusive word. Anything that contributes to the welfare of a community, in any way, is a social contribution. In this sense, the results of education and of religion are also social. I am using the word in no such general sense, however, but simply to include the betterment of city conditions for living.

A botanic garden is a social contribution because it is one answer to the problem of congestion. It is not sufficient to have open spaces, even when those spaces are beautified as parks. There can not be too many of these, but something more is needed. I wonder if you all appreciate what the touch of nature means. It is something more than open space for breathing. It is a kind of elixir that helps men to be *men*. The garden is a museum of nature, not merely an area left to nature. In it there are assembled the representatives of many regions, so that it gives a world contact. It is a great service to give any community the opportunity of such a contact.

The contact with nature presently develops the contact of interest, and interests outside the routine of living, when these interests are worth while, are both curative and stimulating. Then when interest is awakened, and plants are examined as individuals, and not merely as a general population, the wonders of plant life begin to appear. I wonder how many know why leaves are green and flowers colored; why some plants are trees and others herbs; why some trail and climb, and others stand erect. All of this vegetation is the natural covering of the earth, which cities have eliminated. It is the covering that makes your lives and all life possible. I should say, therefore, that the mere presence of a botanic garden in a city is like having the spirit of nature as a guest, and all who become acquainted with this spirit are the better for it.

There is nothing more artificial than city life, and therefore nothing more abnormal. Some are able now and then to renew their contact with the natural and normal, but most are not. A botanic garden brings to the many a touch of what only the few can secure for themselves. You have doubtless developed some very definite and effective ways of expressing the social contribution of this garden to the life and welfare of this community. But to me, speaking in general terms, the conspicuous *social* contribution is to provide the opportunity, and see to it that all the people take advantage of it.

2. The second is the *educational* contribution. It is this contribution to the community that you have developed with remarkable success. Nature is a great teacher when she really comes in contact with the pupil. The notion is too prevalent that knowledge comes from books; that one can read *about* nature and acquire knowledge *of* nature. One might just as well try to acquire knowledge of business by reading about business. Knowledge comes from experience, from contact. We

must distinguish between *knowledge* and *information*. Knowledge is first-hand, obtained from actual contact with the material. Information is second-hand, hearsay, coming from no actual experience. Reading *about* nature, therefore, brings information.; contact *with* nature brings knowledge. To serve a community by bringing its children into contact with nature is a great educational service.

Perhaps the most significant contact with nature is the handling of plants. We are seeking now for an army of people with some experience in handling plants; for more people who will cultivate plants wherever space permits. You have been made to realize, in these days of testing our resources, that the most important material problem we are facing as a nation is the problem of food-production and conservation. Food-production has lagged far behind population, and this increasing gap must be closed up. Our science of transportation has far outstripped our science of food-production, so that we have come to depend not only upon a diminishing food supply, but also upon transporting that supply across a continent. To learn to grow plants and to grow them everywhere, especially near our great centers of population, is a crying need.

The development of home gardens, therefore, is not merely a service for social betterment that all recognize, but it is becoming more and more a public necessity. Any institution that gives you and your children this training is not merely an educational institution, but also a public benefactor. A Botanic Garden doing such work is like a power house, radiating energy throughout the community. Such training is an equipment which not only enriches life, but it is also an equipment for service. In providing such an opportunity, a city can do nothing better for its young people and its homes, and through them for itself.

These two contributions, social and educational, seem very obvious, but the third contribution needs fuller explanation.

3. The third is the *scientific* contribution. This I regard as your great opportunity, and I wish to help you realize it. We are a very practical people, and unless we can see immediate returns from an investment, we decline to undertake it. Very few people appreciate what it has taken to make things practical. We speak of fundamental science and practical science; sometimes we call these two phases pure science and applied science. The general impression is that pure science holds no relation to public welfare, and that applied science serves our needs. You should know that all applied science depends upon pure science; that there would be nothing to apply unless pure science had discovered it. If we had only applied science, it would soon become sterile. It is pure or fundamental science that keeps applied science alive, that makes progress possible. For example, if Faraday had not worked in pure science, Edison would have had no basis for his wonderful inventions. And so it is throughout the whole range of the practical things we are using to-day. To neglect pure science and support only applied science would be like wanting children and eliminating parents. When I hear those who are regarded as practical men lauding our practical achievements, which certainly deserve praise, but speaking lightly of work in fundamental research, I think of them as those who would praise the practical electric light and forget the impractical, because unseen, power house. Scientific research is the power house that generates all the energy we apply in developing what may be called the machinery of our civilization.

I wish now to indicate, by a single illustration, how such an institution as this may become a great laboratory for public service. My illustration is intended only to indicate how fundamental research is of the greatest service to public welfare, a source of energy to be called upon and applied as needs arise. It is not intended to indicate the specific kind of work that any given garden should undertake; this may well vary, but it is a good illustration of the value of research work in general.

I have indicated the problem of food production that our nation is facing to-day. In some way our food production must overtake our population. Over a century ago certain men were speculating about evolution. The subject of evolution was not a science, because men were *meditating* rather than *investigating*. Certainly nothing could have seemed farther removed from general human interest than this speculation. About a century ago speculation about evolution merged into the science of evolution when men began to observe the facts upon which such a theory could be based. For a century, observation and inference went on until they had reached the limit of usefulness. Near the beginning of this century, men concluded that the only way to secure further progress was to test by experiment whether one kind of plant could actually produce another kind. In observing the behavior of plants in breeding, they began to uncover the laws of heredity; and as knowledge of these laws increased, it became evident that this knowledge could be applied to the practical handling of plants, and what we call our revolution in agriculture followed. It is a far cry from a speculation about evolution to the solution of our food problem, but the continuity is unbroken. It is by such essential and generally unrecognized service that scientific research is contributing to human welfare. I wish to be more specific and to indicate some of the ways in which science has solved this food problem.

Through scientific work in the study of heredity, we have learned to multiply the races of our useful plants so that they may fit in more exactly to the variable conditions in which plants must be grown. It is a curious fact that we have been blind so long to the teaching of nature that conditions for plants are not the same everywhere. We have always realized that the natural vegetation of this country is not a monotonous covering. Every change in vegetation indicates a special set of conditions for plant growth, and yet we have been trying to grow the same races of plants everywhere. The result has been that we have gotten maximum returns from some areas, minimum returns from others, and medium returns from the rest. Our total result has been an average. By multiplying races of plants to fit conditions more closely, our total result will not be an *average,* but a *maximum* everywhere. This one suggestion of science will double our production.

One of the most destructive enemies of our crops is drought. On the average our production is cut in half by this enemy. Scientific investigation has shown that it is possible to develop drought-resistant races of all our useful plants. This means the possibility, not only of insuring our crops against drought where they are now cultivated, but also of increasing enormously the area of cultivation, by adding the so-called arid regions of perpetual drought.

Another destructive enemy of our valuable crops is disease. The government has expended millions of dollars in the study of plant diseases, in the hope of reducing the loss. The scientific work of recent years has shown that it is possible to breed disease-resistant races. Plants, like human

beings, differ in their susceptibility to diseases. Some are immune, and others are susceptible. This means that we can cultivate immune races and let the susceptibles perish. We can not handle human diseases in this way. Before what we speak of as the wonderful advance of medicine, we were unconsciously practising selection of the human race for immunity. The susceptibles disappeared and the immunes survived. Now medicine has been so successful that it saves the susceptibles and keeps them mixed with the immunes, so that our human problem is more difficult than it used to be. But we have no such sentiment about plants, and we can cultivate immunity and eliminate susceptibility.

I am told by those who are trained in collecting such statistics that if these suggestions of scientific research can be generally applied, our food production will overtake our population. It is in such ways that the results of science find application. This is not merely a local service, but a national service, and in such a time as this it is a patriotic service.

May I call your attention to the work of the National Research Council in connection with your opportunity. This council has been appointed by the National Academy of Science at the request of President Wilson. Its purpose is to bring into cooperation all of our scientific equipment in an attack upon the problems we are facing. This week we have been canvassing the problems that need immediate attention, and they are to be assigned to various research centers, where properly trained men and adequate equipment are available. I want to include this institution in these assignments. Your opportunity is an unusual one, for already you have many things that are needed. You have the opportunity to respond to this call from your country, and to see to it that research is properly provided for. Such research work not only provides what are called the sinews of war, when war becomes necessary, but it also means progress and power in time of peace. It is this opportunity that led me to say earlier in this address that perhaps you have builded better than you knew.

Do not be misled into thinking that only those problems should be attacked that have been developed by some immediate need. Research is like the exploration of a new country. It must be traversed throughout; all trails must be followed and mapped. Some trails will lead to rich lands and valuable mines; others will not. No one can tell until everything has been explored. Your research work here should mean an exploration of nature as represented by plants, and there is no more important region of nature. The more we know about plants, the more intelligent we become in handling them. I have known scientific explorers who discovered a new country and mapped it, but no one at the time recognized it as good for anything. Years afterwards it was discovered that it was rich in possibilities.

Years ago an Austrian monk, working in his monastery garden, discovered some interesting behavior in the plants he was breeding. He recorded his facts and his conclusions in an obscure journal, and no one paid any attention to it. What could be expected from a monk pottering in his garden? Years afterwards, the contribution was discovered, and to-day it is the basis of most of our work in the study of heredity, and this in turn has made our agriculture scientific. No one knows what may turn up in a garden like this one of yours. It is a gold mine of opportunity. See to it that it is cultivated.

JOHN MERLE COULTER
UNIVERSITY OF CHICAGO

THE IDEALS AND OPPORTUNITIES FOR A BOTANIC GARDEN[1]

I HOLD in my hand a rare and, especially on this occasion, exceedingly interesting little volume. Its title is "Address at the Inauguration of the Hunt Botanical Garden, in Brooklyn, N. Y.," delivered in the Athenæum at the vernal exhibition of flowers of the Brooklyn Horticultural Society, on the evening of April 11, 1855, by Francis Vinton. Sixty-two years ago, almost to a day was inaugurated the first effort to establish a botanic garden in Brooklyn.

Apparently no enterprise could have been launched under more auspicious circumstances. Thomas Hunt, after whom the Garden was named, endowed it with fifty thousand dollars in money and one third of the ground which the garden was to occupy, estimated to be worth at that time ten thousand dollars. This was a large endowment and a specially munificent gift for the year 1855.

In addition to Mr. Hunt's endowment, William C. Langley, Esq., gave one third of the land and five thousand dollars in money, while Henry A. Kent, Esq., gave the remaining third of the garden plot and twenty-five hundred dollars in money. The total value of the endowment, in money and land, was thus $87,500, or nearly $10,000 more than the endowment of the Brooklyn Botanic Garden after seven years of existence.

Said the optimistic orator on that occasion:

> Let this night of the inauguration of the horticultural garden ever be the anniversary of the successful enterprise that, year after year, shall bless, more and more, the young and the aged, the rich and the poor, young men and maidens, old men and children, parents and friends, to the latest generation.

Alas, for the best laid plans of mice and men! The institution, apparently so firmly established, proved to be, not a perennial, but an annual plant. At the close of one year, owing to a combination of circumstances, the land (located on Fifth and Sixth Avenues, between 57th and 60th Streets) and also the cash endowments, reverted to the original donors, and the Hunt Botanical Garden has perhaps never been publicly heard of in Brooklyn from that year until the present moment.

The institution whose main building we dedicate to-night is the third botanic garden projected within the city limits of Brooklyn. The second one is designated and laid out in the original plans for Prospect Park, but so far as I can learn, its realization was never attempted.

As President Healy has already noted, the first suggestion for our institution came from the late Professor Franklin W. Hooper, but the idea of having it administered as a department of the Brooklyn Institute of Arts and Sciences, in cooperation with the city of New York, was made by Mr. Alfred T. White, chairman of the Botanic Garden Governing Committee of the Institute trustees. Not the least of my pleasures in giving a brief address this evening is to make grateful public acknowledgement, not only of the generous gifts of Mr. White and his two sisters, but of his untiring devotion to the interests of the Garden, and his personal interest in and attention to everything that concerns its welfare, and especially its usefulness to this community.

The first rough plans for the laboratory building and plant houses were prepared by the present director of the Garden at Columbia, Missouri, in January, 1910, and submitted to the architects, Messrs. McKim, Mead & White for study and elaboration.

The appointment of the director, made in February, 1910, took effect on July 1 of the same year. On the fourteenth of the

[1] Address at the dedication of the laboratory building and plant houses of the Brooklyn Botanic Garden, April 19, 1917.

preceding February the Board of Estimate and Apportionment of the city of New York was requested to issue corporate stock of the city for the erection of the building, and the plans and specifications for the first section were advertised for public letting during October and November, 1911.

On January 18 the contract was awarded to Cockerill & Little Co., the lowest bidders. The building was to be completed in 150 working days from April 1, 1912. Excavation began on April 8, but owing to numerous exasperating delays the Garden staff was not able to occupy the first section of the building until September 24, 1913, approximately one year after the date specified for the completion of the contract.

The work of the Garden, administered for over three years from a temporary office in the Brooklyn Museum, had reached such proportions that the small first section was quite outgrown before it was occupied. The small plant houses became greatly overcrowded, both with plants and with classes; our one lecture room and class-room made it possible for us to respond to only a fraction of the demands made upon us by the schools and the general public; part of our library and thousands of specimens of our herbarium were packed away in storage, inaccessable for daily use; of laboratory accommodations we had almost none; further growth was impossible, stagnation was out of the question, for the Botanic Garden was a living institution, young and vigorous.

The state of the city's finances, resulting from the enormous cost of necessary public improvements, made it necessary for the most efficient board of estimate and apportionment the city has ever had to administer the public funds with the strictest economy, making appropriations of corporate stock only for necessary or very urgent purposes. This was the situation confronting our garden in May, 1915, when the chairman of our governing committee, realizing the urgency of our need, and believing firmly in the value of our work to this city, as well as to education and science in general, secured private funds to the amount of $100,000 on the condition that the city appropriate corporate stock in the same amount for the completion of our buildings, and other permanent improvements of the Garden. The terms of the gift were accepted by the city administration, the corner-stone was laid just one year ago to-morrow (April 20, 1916), and to-night we dedicate the building.

One can not help but recall at this time how very recent is the development of scientific laboratories. By whatever way you come to this building this evening you were dependent for your transportation upon an electro-magnet; electro-magnetism was discovered by Faraday in 1831, and the laboratory in which he worked was the only research laboratory then in existence. The epoch-making discoveries of the great French physiologist, Claude Bernard (about 1870), were made in the damp, unsanitary cellars of the Collège de France. It was indeed impossible, says M. Vallery-Radot, to dignify these cellars by the name of laboratories; Bernard himself called them "scientists' graves"—a prophetic name, for it was Pasteur's opinion that the disease which caused the death of Bernard was induced by the unhealthful conditions in which he was obliged to work. The laboratory of the Sorbonne was equally bad, dark and damp, and several feet below the level of the street. As late as 1871[2] there

[2] The first botanical laboratory in the United States for undergraduate instruction was introduced at Iowa Agricultural College (Ames) by the late Professor C. E. Bessey, in 1873. The laboratory method for advanced students is said to have been introduced the year previous at Harvard, but this was unknown to Bessey.

was no botanical laboratory of any sort in the United States. The museum and laboratory building of our sister institution, the New York Botanical Garden, completed in April, 1901, was the first building of any considerable magnitude in this country constructed for the sole purpose of botanical instruction and research.

What a change, and what an appropriate and heartening change, in the past twenty-five or thirty years, for now all of our better colleges and universities are planning adequate housing for their botanical work, and in many institutions this ideal has already been realized.

As many of you have already seen, the architects have made this a building of great beauty. A well-known magazine recently published a view of the Woolworth building, in New York, entitling the picture "a cathedral of commerce." And why should not commerce, and science which promotes commerce, have their beautiful buildings? Nothing has done more to give us a deep insight into divine mysteries, to correct false notions of deity, to produce a sane and wholesome attitude of mind toward the universe and man's relation thereto than the study of science, especially during the past fifty years. I like to think that there is something truly significant in the fact that the architectural motive of this laboratory building was drawn from churches such as are not uncommon in northern Italy.

But what is this building for, and what is a botanic garden? A botanic garden is an institution for the advancement and diffusion of a knowledge and love of plants; the particular purpose of the Brooklyn Botanic Garden is the advancement of botany and the service of the city.

But how, you ask, can a botanic garden serve the city? Without hesitation I reply, primarily by the advancement of botany, secondarily in many related ways. How the means indicated are adequate to achieve the result is still not clear to those who are inclined to think of botany, not as a man's work, as a science fundamental to the oldest and most essential of all human occupations, namely agriculture, but merely as a pleasant pastime for young ladies in a "finishing school," or as a rather heroic method of learning to recognize a few native wild flowers and to pronounce their Latin names. My time is too short and the hour is too late for me to go into details, but I may briefly illustrate by citing a line of work now in progress here, namely, a survey of the diseases of the trees and shrubs of Prospect Park and the Botanic Garden. During the past ten years the boroughs of Brooklyn and Queens have lost chestnut trees to the value of several hundred thousand dollars through the ravages of a tree disease which no one knows how to combat. Would it not have been worth much more than the annual cost of maintenance of both botanic gardens of the city to have known how to check the chestnut blight, and how to cope with equally destructive diseases now threatening several other kinds of trees?

But of far greater importance than a knowledge of how to grow trees in a city, or how to combat the diseases of crop plants, is the instilling in the general body of our citizens of correct habits of thought and a correct attitude of mind in the face of such problems. To observe accurately, to record faithfully, to reason logically, to keep an open mind, to welcome truth regardless of consequences, quickly to recognize error, to make no compromise with charlatanism—this is the scientific habit of thought and work. It is the only method by which knowledge is advanced; it characterizes all research in this and similar institutions; it is the indispensable spirit of all scientific instruction, both elementary

and advanced; *it is the greatest educational need of to-day.*

Never more than now was our educational atmosphere so surcharged with a clamor for "efficiency," which, in many minds, is synonymous with the idea that the chief end of education is to enable one to get a living. But the scientific habit of mind, briefly outlined above, equips one, not only to get a living, but to live. To belittle the importance of equipping our youth to succeed in some vocation would be folly; it is greater folly not to recognize the importance of equipping them to spend their hours of recreation in something more wholesome and beneficial than movies and cheap vaudeville.

To educate one to think straight and to keep his thoughts in the realm of the useful and beautiful is of more fundamental importance, is more "practical," if you please, than any other end to be sought by education. The knowledge to be obtained by nature study and the study of botany is of large importance, but the by-products of these studies, as here indicated, are the larger values. The work of public instruction as organized at the Brooklyn Botanic Garden affords an additional opportunity for our citizens to obtain such advantages —knowledge in which they are interested so presented as to bring pleasure, to build character, and, in many cases, to serve as the foundation of a successful life work. This is preparedness of the most thoroughgoing sort, for it not only goes to the root of things, but it serves the nation at all times and under all circumstances, in peace as well as in war.

Two writers in a late number of SCIENCE,[3] discussing the recent debate in the House of Lords between Lord Haldane (*pro*) and Lord Cromer and Viscount Bryce (*con*) on the extension of science teaching, and the place of science in education, call attention to the fact that "science is *finding out* and *learning how*," and is not to be thought of in terms of its results. Any system of education that does not provide ample opportunity for training in finding out and knowing how is fundamentally faulty. It is the duty of every state, of every city, to see that its educational system makes suitable provision for this kind of discipline.

Such opportunities, within the realm of botanical science, are afforded at the Brooklyn Botanic Garden by our own classes, taught by members of the Garden staff, by lectures and nature stories for adults and children, and by opportunities afforded here for teachers of the public and private schools of Brooklyn to bring their pupils for a first-hand study of plants in field, conservatory and laboratory. When a boy comes to the Botanic Garden regularly every Saturday for a year or more, clear from Staten Island, a round trip journey consuming from three to three and a half hours, one may be sure that what he receives here partakes of the nature of fascination, and possesses unmeasured importance in the making of his character and in his preparation for a useful career. This is only one illustration of many that might be given, of how our work is appealing to an increasingly large number of young people.

As a result of the present international situation there is now a widespread movement to bring all available land, especially in cities, under cultivation. This phase of preparedness was inaugurated in Brooklyn by the Botanic Garden some three years ago by the starting of back-yard gardens, and the distribution of penny packets of seed. During the past three years we have distributed over 311,000 penny packets of seeds to the children of Brooklyn, and have inaugurated and inspected from 1,200 to 1,400 back-yard gardens. With the more ample quarters made available by our com-

[3] SCIENCE, N. S., 44: 841–844, December 15, 1916.

pleted building, opportunity is afforded for the expansion of this work several fold.

A brief word for scientific research and I am done. There is now nearing completion in this city one of the most stupendous works of engineering ever brought to a successful completion. I refer to the new water supply system. But what would the city say to the proposition that it should confine all of its efforts to building the conduit for this water, and should leave to some other city, or to some county, or to the state, the expense and the work of providing the reservoir and keeping it adequately supplied with water? The answer does not need to be stated.

But now transfer the simile to education. What a sorry spectacle would be an institution such as ours, calling itself educational and scientific, and yet content to be merely a conduit of information procured from a fountain head located elsewhere, and to which it made no contribution. It is the supreme—the supreme—business and duty of an institution like this, to be creative, productive; not merely a purveyor—a channel of distribution. Our debt is to science as well as to the people. We owe it to the people to disseminate knowledge; we owe it to science not to be parasitic on the body of knowledge, but organically connected with it in a relationship of mutualism—of mutually advantageous symbiosis—giving as well as receiving, constantly enriching the storehouse from which we draw. This is the only relationship which makes for healthful vigor, for perennial enthusiasm, for largest accomplishment, for the most valuable and solid service to the community. Does the great metropolis of New York wish otherwise—wish less than this for its educational and scientific institutions? I believe it does not. We are now living in the early years of an epoch when municipal support of the important work of finding out and learning now is to be considered as important and proper a function of municipal government as acquiring water sites and building aqueducts.

In a recent address on "The Support of Scientific Research in a Democracy," Professor James McKeen Cattell called attention to the fact that the manufactures of the city of Pittsburgh and Allegheny county are worth more than three hundred million dollars a year. These manufactures have all been made possible by the applications of science. Ten per cent. of their value—thirty million dollars a year—says Professor Cattell, might to advantage be spent in that city for the future advancement of science under the auspices of the University of Pittsburgh. At first thought, this proposition seems as startling to the "impractical" scientist as it does to the "hard-headed" business man. But why should this not be done?

In a letter from the Secretary of the Board of Water Supply of New York City, I am informed that the land owned by New York City about the Ashokan reservoir covers a total of 15,254 acres. Six thousand of these acres are forested with so-called second growth of white oak, rock oak, red maple, sugar maple, hemlock and white pine. The letter contains this significant sentence: "The chestnut growth is being removed on account of mortality from pests." There have been planted by the city on this watershed over 1,470,000 coniferous trees, more than 1,000,000 of which include six species of pine. The present value of these pine trees may be conservatively estimated at not less than $1,000,000 dollars, and the value increases from year to year—likewise their importance to the city's water supply. It is now common knowledge that some of these species of pine are being attacked by a fatal disease, the blister rust, recently imported into this country from Europe. Damage to the extent of hundreds of millions of dol-

lars is known to be caused every year in this country by imported plant and tree pests. Whose concern should it be to take every possible measure to learn the nature of the pine-tree blister rust which threatens property of New York City to the extent of several millions of dollars? Would it not be a perfectly reasonable business proposition to expend annually 10 per cent. of the value of the trees on the Ashokan watershed in order to ascertain effective means for the control or eradication of a tree disease which may necessitate a replanting of the entire area?

Several million dollars worth of potatoes are consumed in greater New York every year; who should be more interested than the residents of this city in supporting botanical research that has for its object the eradication of potato diseases in Maine, whence a large percentage of our supply is derived?

By the scientific and educational opportunities which it can afford our citizens, by diffusing in this community, and from this community as a center, a knowledge and love of plants, by botanical investigations in the realms of pure and applied science, the Brooklyn Botanic Garden can yearly render to the city of New York a service whose value will be far in excess of any sum of money that will ever be necessary for its annual maintenance.

At the opening of the Pasteur Institute, in Paris, in 1888, the founder of the science of bacteriology, near the close of his address, spoke as follows, smarting as he always did, at the memory of the events of the Franco-Prussian war:

> If science has no country, the scientist should have one, and ascribe to it the influence which his works may have in this world. If I might be allowed, Mr. President, to conclude by a philosophical remark inspired by your presence in this Home of Work, I should say that two contrary laws seem to be wrestling with each other nowadays; the one a law of blood and of death, ever imagining new means of destruction, and forcing nations to be constantly ready for the battlefield—the other, a law of peace, work and health, ever evolving new means of delivering man from the scourges which beset him.

These words seem written for the present occasion. Almost the entire civilized world is at war, but the ultimate triumph of freedom over tyranny, of civilization over vandalism, of right over wrong, may now be confidently predicted; peace, let us hope, is not far distant. In the realm of the intellect there is perpetual conflict of light over darkness, right over wrong, knowledge over ignorance and superstition. But the strongholds of ignorance and superstition, while perpetually yielding are eternally holding out. We shall never know it all, there will forever be ample opportunity for and need of scientific research—of the advancement and diffusion of knowledge. This is man's largest opportunity, the ultimate source of his greatest happiness.

C. STUART GAGER
BROOKLYN BOTANIC GARDEN

THE SCIENTIFIC WORK OF THE BUREAU OF FISHERIES

AFTER most careful consideration of its responsibilities in the present national exigency, the Bureau of Fisheries has determined upon the following principles and plans for its immediate guidance:

1. The service of science to fishery work is of such great possible significance that it would be a serious error to abandon the pursuit of proper scientific investigations.

2. The exigency of the national food situation is such that every practicable and proper effort should be made to bring about a greater production of fish and a better utilization of the available supply.

3. The conflict between the two principles just mentioned is more apparent than real, as may appear from the following statement of the bureau's plan.

4. The bureau will not interrupt important investigations which have been pursued for

periods of years and which must be continued in order to gain the desired results.

5. As between new investigations which may be expected to yield returns after a long period of years and those which may be expected to produce results in time to serve the immediate needs of the country, preference will be given to the latter.

6. In the latter class are studies—biological, biochemical, physiological and technological—relating to the propagation and rearing of fish, the protection of fish, the utilization of fishery products, etc.

7. The bureau is not only utilizing its permanent scientific staff to the fullest extent, but is gladly availing itself of the valuable assistance offered by biologists, physiologists and chemists from various universities.

8. For the immediate present certain economies are being practised. This does not mean a policy of niggardliness; on the contrary, expenditures must in many respects be more liberal than hitherto. It does mean, however, the temporary curtailment or cessation of certain customary activities which can not be continued in a satisfactory manner during the immediate period of necessary readjustment.

More specifically the bureau's plans for scientific work in the near future may be stated as follows:

The marine laboratory at Beaufort, N. C., will not be opened for general investigations during the coming summer. The Woods Hole laboratory, while temporarily closed for general investigations, will have a small special staff for experimental work in the utilization of fishery products. The fish-culture experiment work of the Fairport, Iowa, laboratory bears so directly upon the immediate problems of food supply that the activities of the station will suffer no curtailment, but will be somewhat expanded. In the class of field investigations, some will be continued, some abandoned and some new studies undertaken.

Not as a complete catalogue of investigations provided for, but as illustrating the topics regarded as proper for the bureau's attention at this time, the following may be selected: The relation of fishes to mosquito extermination and to public health; the habits and propagation of salmon in Pacific waters; the natural history, propagation and protection of the blue crab; problems of the oyster industry; experiments in curing fishes; the properties of the roe of certain fishes alleged to be toxic or distasteful; various other investigations relating to the utilization of fishery products; dragon-flies and damsel-flies in relation to the culture of fishes in ponds; aquatic plants in relation to the culture of fishes in ponds; parasites affecting fish culture in ponds, life-histories, and means of control; systematic relations, habits and migrations of salmonoid fishes in the Great Lakes; biological and physical conditions of fish life in enclosed waters; the protection of wood against marine borers; the utilization of marine algæ, and the relation of kelp harvesting to the fisheries.

H. M. Smith,
Commissioner of Fisheries

Washington, D. C.,
June 18, 1917

SCIENTIFIC EVENTS

CONCERNING THE MANUFACTURE OF PHTHALIC ACID AND PHTHALIC ANHYDRIDE

The Department of Agriculture announces that the color investigation laboratory of the Bureau of Chemistry, of this department, has perfected, on a laboratory scale, a new process for the manufacture of phthalic acid and phthalic anhydride. This process, as carried out in the laboratories, appears so promising that it is thought that some manufacturers of chemicals and dyestuffs in this country may be able to supply their demands for these compounds by this process, provided the process can be reproduced upon a technical scale so as to obtain results commensurate with the laboratory investigations.

With a view to helping the chemical industry of this country, the Department of Agriculture hereby announces that it is ready to assist manufacturers who wish to produce these compounds. The expenses of the technical installation and of the labor and materials necessary will of necessity be borne by the firm, individual, or corporation wishing to manufac-

ture the products. The chemists of the color investigation laboratory will assist with expert advice, etc. The department reserves the right to publish all the data obtained from the technical experiments.

Since it seems very desirable that phthalic acid and phthalic anhydride be made available in large quantity in this country at the earliest possible moment, this offer of assistance will not be held open by the department for an indefinite period. D. F. HOUSTON,

Secretary

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.,
June 16

THE CROCKER LAND EXPEDITION

DR. HARRISON J. HUNT, surgeon of the Crocker Land Expedition, arrived in New York on June 20, on the Danish steamer *United States* and reported the story of his journey by sledge over the young ice of Melville Bay. He said that the other members of the Crocker Land Expedition were in excellent health when he left them, but that, owing to their supplies being very low, it is imperative that relief be sent to them at once. The Committee-in-Charge had sent Captain Robert A. Bartlett to take command of the sealer *Neptune,* the third relief vessel which has been chartered in behalf of the Crocker Land Expedition.

Doctor Hunt left North Star Bay on December 18, 1916. He was accompanied by another member of the party, W. Elmer Ekblaw.

"The steamship *Danmark,*" said Doctor Hunt, "which had been sent by the Committee-in-Charge, was at North Star Bay when I began my journey south. Mr. Donald B. MacMillan, leader of the expedition, Professor Edmund Otis Hovey and Jonathan Small—another member of the party—were at Etah. Their supplies will last until about the 1st of August and the members will then be dependent upon what walrus and caribou meat they could obtain at Etah. They might also get eider-duck eggs. They have very little coffee, sugar and canned fruits and flour was being rationed out. They may get some supplies from the *Danmark* by sledging a hundred and fifty miles to her. That vessel is in about six feet of ice and possibly she will be freed about the 1st of August. She has stores but is short of coal. I was glad to hear, on my arrival here, that the Committee has already arranged to send the *Neptune,* such help as is urgently needed. Another year in the Arctic would prove a great hardship to the members of the Expedition and might result in fatality."

Dr. Hunt and Mr. Ekblaw left North Star Bay with six sledges and were accompanied by five Eskimos. There was deep snow and the weather was generally bad. When they got out on the ice of Melville Bay they found that the winter had been comparatively open and that the ice, which was three inches in thickness and very porous, was continuously bending beneath them. The long sledge journey of fourteen hundred miles, which took from December 18, 1916, until April 16, of this year, was attended by many perils. Knud Rasmussen, the Danish explorer, who went part of the way with the scientists, as well as old Eskimos, said that the conditions for sledging were the worst they had ever seen. The later part of the journey was undertaken by Dr. Hunt accompanied only by Eskimos, as Mr. Ekblaw remained at South Upernavik.

Dr. Hunt said that from the scientific point of view the Crocker Land Expedition, which was sent out under the joint auspices of the American Museum of Natural History, the American Geographical Society and the University of Illinois, was obtaining excellent results.

Mr. Donald B. MacMillan—the leader of the expedition, has gathered an enormous amount of valuable scientific data. Dr. Hovey, who is probably the best equipped geologist who has ever gone into the Arctic, is in excellent health and spirits and is doing splendid work. He has set up the seismograph at Etah and has arranged to make extensive observations of all kinds.

Captain George B. Comer, the veteran ice-pilot, who was sent north on the first relief expedition, is a man of considerable scientific attainments. When this hale mariner is not engaged in his call-

ing he makes researches in archeology. He is now conducting some most important work in the study of the remains of the ancient peoples of the north.

APPLIED PSYCHOLOGY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

Professor G. M. Whipple has leave of absence from the University of Illinois for the first semester of the coming year to serve as professor of applied psychology at the Carnegie Institute of Technology and acting director of the Bureau of Salesmanship Research.

Professor Walter Dill Scott, who had originally planned to return to Northwestern University for the next semester, has been given further leave of absence and will remain at Carnegie throughout the year.

A. J. Beatty, Ph.D., Illinois, has been appointed research assistant in the Bureau of Salesmanship Research, and is already engaged in a study of methods used in corporation schools for developing salesmen.

Fellowship appointments include the following: N. L. Hoopingarner, University of Texas; Franklyn Meine, University of Chicago; H. G. Kenagy, University of Minnesota; and C. E. Brundage, Tuck School, Dartmouth.

Beardsley Ruml, Ph.D. Chicago, has been appointed instructor in psychology. L. L. Thurstone has been advanced from assistant to instructor. These, together with Professor J. B. Miner, Professor Kate Gordon and Professor W. V. Bingham, head of the department, will be primarily concerned with mental measurements of students and with research and instruction in vocational psychology.

SCIENTIFIC NOTES AND NEWS

The late Mr. W. Hudson Stephens, of Lowville, N. Y., a life member of the American Association for the Advancement of Science since its eighteenth meeting held in Salem in 1869, by the terms of his will has bequeathed the sum of $5,000 to the association.

Dr. James Mason Crafts, distinguished for his chemical researches and for a time president of the Massachusetts Institute of Technology, has died in his sixty-ninth year.

Yale University has conferred the doctorate of science on Dr. Theobald Smith, director of the department of animal pathology of the Rockefeller Institute, and Sir Ernest Rutherford, director of the physics laboratories of the University of Manchester, former Silliman lecturer at Yale. William T. Hornaday, director of the New York Zoological Park, received the degree of master of arts.

Professor Robert A. Millikan, professor of physics at the University of Chicago, has been made doctor of science by Amherst College. The doctorate of laws was conferred on Nathaniel M. Terry, of the class of 1867, professor of physics and chemistry in the U. S. Naval Academy.

The degree of doctor of science has been conferred by Dartmouth College on Allen Hazen, the civil engineer of New York City.

Bowdoin College has conferred the doctorate of science on A. H. Sabin (class of '76), consulting chemist of the National Lead Company and lecturer in New York University, and on Dr. F. H. Albee, of the class of '99, the New York surgeon.

Professor John E. Bucher, who holds the chair of chemistry at Brown University, has been given the doctorate of science by that institution.

Dr. Chas. H. Herty, editor of the *Journal of Industrial Chemistry,* has been given the degree of doctor of chemistry at the University of Pittsburgh.

The Société Russe de Minéralogie de Petrograd, which before the revolution carried the title Société Imperiale de Minéralogie de St. Petersbourg, held its centenary jubilee in January, 1917, on which occasion John M. Clarke, of Albany, was elected to honorary membership.

The forty-six knighthoods conferred on the occasion of King George's fifty-second birthday include Dr. H. P. Waterhouse and Mr. R. Jones, surgeons, and Mr. R. T. Glazebrook, director of the National Physical Laboratory.

ENGINEER REAR-ADMIRAL G. G. GOODWIN, C.B., has been appointed engineer-in-chief of the British fleet in succession to Engineer Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S.

FORMER and present graduate students of the department of psychology of Cornell University and a number of his more intimate friends among the faculty met with Professor E. B. Titchener in the Psychological Laboratory on the evening of June 22, to celebrate the completion of twenty-five years of his service to Cornell. A volume of "Studies in Psychology," edited by Professors W. B. Pillsbury, J. W. Baird and M. F. Washburn, was presented to him on the occasion. After the presentation, Professor Titchener responded with some reminiscences of the early days of the Cornell Laboratory, and in conclusion announced that he had declined acceptance of the chair of psychology recently tendered him by Harvard University.

IN the annual report of the visitors of the Oxford University Observatory they express their sorrow at the death of the late Professor Esson, who acted as secretary to the visitors during the whole forty-two years of the work of the observatory. Several lectures to military bodies have been given by the director, Professor H. H. Turner, including lectures in France and in the camps on Salisbury Plain.

THE fifteenth annual session of the South African Association for the Advancement of Science, as we learn from *Nature,* will be held at Stellenbosch, from July 2 to 7, under the presidency of Professor J. Orr. The sectional committees and their presidents will be as follows: A: Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture and Irrigation, Professor W. N. Roseveare; B: Chemistry, Geology, Metallurgy, Mineralogy and Geography, Professor M. M. Rindl; C: Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene and Sanitary Science, J. Burtt-Davy; D: Education, History, Mental Science, Political Economy, General Sociology and Statistics, Rev. Professor N. J. Brümmer; E: Anthropology, Ethnology, Native Education, Philology and Native Sociology, Rev. N. Roberts. The local secretary is Professor B. van der Riet, Victoria College, Stellenbosch.

PROFESSOR HUGO DE VRIES is preparing, as has been noted in SCIENCE, a new experimental garden and laboratory in Lunteren. He has now transplanted to it the young rosettes of his cultures of *Œnothera.* He plans to continue at Lunteren the work which he had been doing at Amsterdam.

THE official duties of Professor Robert A. Millikan, of the department of physics at the University of Chicago, who has been in Washington during the spring quarter as vice-chairman of the National Research Council, which is acting in close relations with the Council of National Defense, have delayed the appearance of his new volume on *The Electron,* but the University of Chicago Press announces its publication early in July.

PROFESSOR CARL E. SEASHORE, of the University of Iowa, is giving courses at the summer school of the University of California. He offers special work on the relation of psychology to music.

PROFESSOR JOHN WEINZIRL, head of the department of bacteriology of the University of Washington, Seattle, has obtained leave of absence for the coming year and will study preventive medicine with Dr. M. J. Rosenau, of the Harvard Medical School.

A PORTRAIT of the late Professor Raphael Meldola is being painted by Mr. Solomon J. Solomon, in order that copies may be presented to the Royal Society and the Institute of Chemistry.

A MEMORIAL tablet to the late Dr. S. Weir Mitchell was unveiled at the recent commencement exercises of the University of Pennsylvania.

THE death on June 22 is announced of Professor Leverett Mears, head of the department of chemistry at Williams College.

DR. JØRGEN BRUNCHORST, Norwegian minister at Rome, known for his publications in bot-

any and as director of the Bergen Museum, and editor of *Naturen*, died in Rome on May 20, aged fifty-five years.

The American Medical Journal writes: K. A. H. Mörner, professor of chemistry and pharmacy at the Karolinska Medico-Chirurgical Institute of Stockholm, died recently, aged sixty-two. Since 1892 he has been rector of the institute, in which position he participated in drawing up the regulations for the prizes of the Nobel prize committees, and since has been president of the Nobel Medical Committee. Mörner's research and publications in chemistry, especially physiologic chemistry, toxicology and chemical analysis, were notable.

The United States Civil Service Commission announces an open competitive examination for scientific assistant, for men only, on July 25. Vacancies in the Bureau of Fisheries, at entrance salaries ranging from $900 to $1,400, including a vacancy in the position of fishery expert on the *Albatross,* at $1,200 a year, will be filled from this examination. Further information may be obtained by addressing the Civil Service Commission, or the Bureau of Fisheries, Washington, D. C.

The New Jersey State Board of Health on June 7 denied the application of Rutgers College, at New Brunswick, for permission to teach and practise vivisection under a law of the state. The denial was based on an opinion from the Attorney General's department that the law in question could not be applied to Rutgers. The act was drawn particularly for the Rockefeller Institute. The Attorney General's department held that it applied only to institutions for scientific research and not to educational colleges or schools.

By the will of the late Mr. Washington S. Tyler, of Cleveland, $200,000 is designated for Lakeside Hospital. Half of this is to be used for construction, and the income from the other half for the maintenance of a maternity hospital to be conducted in connection with Lakeside Hospital.

We learn from *Nature* that the late Lord Justice Stirling's herbarium, consisting chiefly of about 6,000 varieties of mosses and liverworts from many parts of the world, has been presented by Lady Stirling to the Tunbridge Wells Natural History Society.

An opportunity for research work in sociology with some time for other graduate work if desired, awaits a suitable applicant at the University of Chicago and for this $1,200 has been set aside for each of the two years it is expected the investigation will require. By this announcement it is hoped to secure some one already specializing in sociology. Inquiry for further details may be addressed to Professor Albion W. Small, University of Chicago, or to Dr. E. R. LeCount, Rush Medical College, Chicago.

The *Weekly Bulletin* of the New York department of health has received a condensed report of the vital statistics of the city of Petrograd for the year 1915. The population for that year was 1,850,000. What stands out most prominently in the report is the fact that there were 2,100 more deaths than births reported during the year, thus showing the effect of the war upon the status of the population. The death rate from typhoid fever was over forty (40) per one hundred thousand, as against six (6) for the city of New York during the same period. Four hundred and fifty deaths were reported from smallpox. The death rate for measles, scarlet fever, diphtheria and croup was far above that of the city of New York. Tuberculosis had a death rate double that of New York. Two hundred and fifty, out of every 1,000 born, died during the first year, as compared with 95 in the city of New York.

Recent accessions to the University of Arizona Museum include ethnological collections as follows: Eighty-five representative Apache baskets from Governor G. W. P. Hunt, Phœnix; 300 representative Pima baskets from Perry M. Williams, Maricopa; 9 representative Paluate baskets; 12 representative Hopi baskets; 10 representative Hopi pottery; native and ceremonial Hopi costumes; native Navajo costumes, by the University of Arizona

expedition of 1916. The archeological collections include more than a thousand specimens of prehistoric pottery, textiles, weapons and implements from the Cliff and Pueblo ruins of northern Arizona, by the University of Arizona.

THE university senate of Western Reserve University has voted to establish a committee on research to be affiliated with the National Research Council. The committee is composed of Dr. George N. Stewart, chairman, School of Medicine; Dr. Torald Sollmann, vice-chairman, School of Medicine; Professor H. P. Cushing, secretary, Adelbert College; Professor H. W. Springsteen, Adelbert College; Professor F. H. Herrick, Adelbert College; Professor O. F. Tower, Adelbert College; Professor H. A. Aikins, College for Women; Professor Edward Spease, School of Pharmacy.

THE Duke of Bedford, who presided at the annual meeting of the Zoological Society of London, on April 30, explained the steps taken by the council to save food. He said that the total number of animals had been very greatly reduced; first, because they had not replaced any of the large animals which had died during the war; and, secondly, because they had destroyed a number of those which could be replaced in normal times. With the reduction of the number of animals came a corresponding reduction in the amount of food consumed. The principle adopted had been, wherever possible, to cease using food which was also human food. The following details were given:

Meat is limited to horseflesh purchased from the army. Never was the supply more abundant or the quality better, on account of the enormous number of horses in government service.

Potatoes.—We used to use over 15,000 pounds a year—we use none now.

Bread formerly used for the apes and monkeys and some small mammals has been replaced by flour not up to the Board of Trade standard for human consumption, and by ship's biscuits which have made one or two voyages unused and are then rejected as no longer fit for issue. The sale of bags of stale bread to the public for feeding the animals has been stopped.

Wheat is no longer used for any of the mammals or water-fowl. As substitutes we use dari, paddy rice and locust beans.

Oats.—The quantity used has already been very greatly reduced and the remainder is being successfully replaced by a mixture of split horse beans and maize.

Hay.—The hay used in the gardens consists of those trusses which the army buyer, who buys first, has not selected. Arrangements have been made to use the cut grass from the London parks and squares, and to use larger quantities of foliage.

Fish.—The fish used is unsuitable for human food, except some small quantities required by birds to which salted or stale fish is fatal.

Eggs.—The eggs used for small soft-billed birds are Chinese pickled eggs or undersized imported eggs.

Fruit.—Bananas, formerly used for a very large number of the small mammals and birds, have been, to a great extent, replaced by boiled mangold wurzels and beetroots. Some few small and delicate mammals and birds refuse to take beetroot, but these exceptions are insignificant. The bananas which are still used, as far as possible, are over-ripe ones, unfit for table purposes, but quite nutritious for animals. The dates used are of a quality not up to the Board of Trade standard for human food.

Sugar.—The sugar used for the animals consists of what is known to the trade as "foot" sugar, which is not suitable for human food, and the total quantity amounts to about 5 pounds a week.

Greens.—About 11 bushels are used a week, but these consist of those not sold for human consumption.

UNIVERSITY AND EDUCATIONAL NEWS

THE American Association of University Professors will hold its next annual meeting at Chicago, probably on December 27 and 28.

As has been noted in SCIENCE, Governor Ferguson has vetoed the legislative appropriation for the University of Texas, amounting to one million six hundred thousand dollars for the next two years. It is said that this was done because the board of regents was unwilling to dismiss the president and members of the faculty. There have been various lawsuits, and the attorney general has now given an opinion that the veto is ineffective.

The new Stanford University Hospital, which is being erected at a cost of approximately $500,000, will, it is expected, be ready for occupancy about October 1.

Mr. V. Everit Macy, commissioner of charities and corrections, West Chester County, has undertaken to support three fellowships, of the value of $500, each for work and investigations in the West Chester County penitentiary.

The following changes have been made in the staff of the anatomical department of the Johns Hopkins University: Dr. Florence R. Sabin has been promoted from associate professor of anatomy to professor of histology; Dr. Lewis H. Weed, from associate to associate professor in anatomy, and Dr. Charles C. Macklin, from instructor to associate. Professor O. Van der Stricht, of the University of Ghent, becomes lecturer in anatomy. Dr. Edmund V. Cowdry, associate in anatomy, has resigned to accept the professorship of anatomy in the Peking Union Medical College which is now conducted by the Rockefeller Foundation of New York. Dr. Eldon W. Sanford becomes assistant in anatomy.

Mr. W. G. Waterman, recently assistant professor of biology at Knox College, has been appointed assistant professor of botany at Northwestern University.

Associate Professor William A. Kepner has been promoted to a profesorship of biology in the University of Virginia.

At the University of Minnesota, Henry T. Moore has been appointed assistant professor and Karl S. Lashley instructor in psychology, with salaries of $2,500 and $1,700, respectively.

DISCUSSION AND CORRESPONDENCE

HERITAGE AND HABITUS

The word "habitus" as distinguished from "heritage" was defined in 1913 by Gregory[1] as follows:

> The totality of the cænotelic or recent adaptive characters of an animal may be called its *habitus;* the totality of its palæotelic characters may be referred to as its *heritage.* The habitus tends to conceal remote phylogenetic relationships, the heritage to reveal them. Thus, the diverse habitus of *Thylacinus, Notoryctes* and *Phascolomys* concealed their remarkably uniform underlying heritage.
>
> The habitus of a race of fishes is the totality of their cænotelic characters, *i. e.,* of all those characters which have been evolved in adaptation to their latest habits and environment. The heritage of a race of fishes is the totality of their palæotelic characters, *i. e.,* of all those characters which were evolved in adaptation to earlier habits and environments and which were transmitted in a more or less unchanged condition, in spite of later changes in habits and environment.[2]

The derivation is, of course, from *habitus,* meaning attire, but by a natural extension habitus is taken to mean among other things, *e. g., facies* (Century Dictionary, p. 2675). The word "habitus" is common property. It is a word of wide significance. Gregory applied it in a limited sense without entirely losing sight of its generally accepted meaning (*e. g.,* habitus of plants).

The terms habitus and heritage may become very useful and be generally adopted among naturalists. The reptilian heritage of ichthyosaurs stands in clearest contrast to their marine habitus; so too the mammalian heritage of bats and cetacea, the primate heritage of man, the avian habitus and diapsid heritage of pterosaurs, the struthious habitus and theropod heritage of *Strouthiomimus,* etc.

Lillie recently uses the term habitus in the same general sense in which Gregory has used it, but the latter gives it a more precise meaning, viz., the totality of all characters evolved in response to the latest or final life zone. "Somatic habitus" as used by Lillie means "general bodily characteristics," while habitus in botany means the sum of the adaptive characters, much as Gregory uses it. These adaptive characters are, of course, inherited.

The words cænotelic and palæotelic, also proposed by Gregory, are perhaps still better terms, because they are self-explanatory to those who know even a little Greek. Cænotelic signifies characteristics evolved during present life habits; palæotelic signifies in-

[1] Gregory, W. K., "(IV.) Convergence and Allied Phenomena in the Mammalia," *Rept. Brit. Assoc. Adv. Sci.,* 1914 (1913), pp. 525–526.

[2] *Ann. N. Y. Acad. Sciences* for 1913, p. 268.

heritance from previous life habits. A cænotelic character of previous life-zone habitus often becomes a palæotelic character in a subsequent habitus. The "somatic habitus" is generally the expression of the latest life habits. HENRY FAIRFIELD OSBORN

SCIENTIFIC MEETINGS IN WAR TIMES

A NUMBER of our scientific societies have deemed it advisable "on account of the war" to either cancel or postpone their future meetings and conventions. The American Electrochemical Society disapproves of this action and at its recent board meeting adopted resolutions encouraging rather than discouraging the holding of meetings.

Modern warfare is not so much a matter of prowess at arms as it is a stupendous engineering undertaking. To hasten this war to an early and victorious close our many thousand engineers must bring to bear every possible effort. However, individual, independent effort is not desirable at this time: *concertive* action is absolutely essential for the most efficient service.

In order to expedite the solution of many of the new problems that have arisen as a direct consequence of our martial state, unrestricted discussion of the problems (with but few exceptions) at scientific meetings is bound to give all of us a clearer understanding of the real points at issues, of the urgent needs of our country at this momentous hour.

Meetings of scientific and technical societies have ever served as a great stimulus for their members and have been a "clearing house" for many of the best thoughts and ideas of our professional men.

Let us follow the good example set us by England. Let us encourage rather than discourage the holding of scientific meetings in these war times. When England found herself confronted with a very serious shortage of sulphuric acid, glass, dyes, electrodes, brass, furnaces, etc., the scientific societies arranged symposiums on these subjects and invited not only all of the members to attend, but, further, urged those factory men who were not members to come to the meetings to give their views and experiences and to learn all they could in return.

Just as a large business corporation depends upon the organized effort and efficiency of the several units and departments, so does our government, now more than ever, look to the organized concertive effort of its large engineering bodies for quick and efficient results. Let us continue our meetings and hold them more frequently than ever before.

COLIN G. FINK

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

THE fourth number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

"A Re-determination of the Value of the Electron and of Related Constants:" R. A. Millikan, Ryerson Physical Laboratory, University of Chicago. The values for the charge on the electron, the Avogadro constant, etc., are given with estimates of the accuracy of the result.

"Body Pigmentation and Egg Production in the Fowl:" J. Arthur Harris, A. F. Blakeslee and D. E. Warner, Station for Experimental Evolution, Cold Spring Harbor, New York. A strong negative correlation exists between the October ear-lobe pigmentation and the egg production of the year.

"Variability of Germ Cells of Sea Urchins:" A. J. Goldfarb, College of the City of New York, and Department of Marine Biology, Carnegie Institution of Washington. The varying behavior of the eggs in the experiments of Loeb, Lillie, Wasteneys and others, was apparently due in large part to variation in the physiologic condition of the eggs they used.

"Transplantation of Limbs:" Ross G. Harrison, Osborn Zoological Laboratory, Yale University. The experiments confirm previous ones, showing that the limb bud is a self-differentiating body: they also show that the laterality of the fore limb may be affected by its new surroundings.

"The Shapes of Group Molecules Forming the Surfaces of Liquids:" Irving Langmuir,

Research Laboratory of the General Electric Company, Schenectady, New York. Cross-sections and lengths are calculated for a variety of molecules. Various theoretical conditions are developed.

"The Importance of the Water contained in the Deeper Portions of the Subsoil:" F. J. Alway and G. R. McDole, Minnesota Agricultural Experiment Station. The moisture of the deeper subsoil will be able to move upward only so slowly and through such a short distance in a single season that it will be at most of no *practical* benefit to annual crops.

"The Transformation of Pseudoglobulin into Euglobulin:" William N. Berg, Pathological Division, Bureau of Animal Industry, Washington, D. C. The loss of pseudoglobulin in the heated sera corresponds almost quantitatively with the gain of euglobulin in the same sera.

"A Case of Normal Embryonic Atresia of the Esophagus:" H. E. Jordan, Department of Anatomy, University of Virginia. A description of the phenomenon for turtles.

"Studies of Magnitudes in Star Clusters, V. Further Evidence of the Absence of Scattering of Light in Space:" Harlow Shapley, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

"The History of the Primordial Germ Cells in the Loggerhead Turtle Embryo:" H. E. Jordan, Department of Anatomy, University of Virginia.

"Studies of Magnitudes in Star Clusters, VI. The Relation of Blue Stars and Variables to Galactic Planes:" Harlow Shapley, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The stellar distribution in the so-called globular clusters has an underlying elliptical symmetry; therefore not only certain nebulæ, our solar system, and the whole galactic system, but even the globular clusters have the oblateness that is general and fundamental in the dynamics of stellar groups.

"Zuñi Chronology:" Leslie Spier, American Museum of Natural History, New York. It has been found possible to establish a chronological scale with applications to American culture-history.

"The Age of the Bolivian Andes:" Edward W. Berry, Geological Laboratory, Johns Hopkins University. There is definite evidence that parts of the high plateau and of the eastern Cordillera stood at sea level in the late Tertiary.

"Large Current-Ripples as Indicators of Paleography:" Walter H. Bucher, Department of Geology, University of Cincinnati. A study of the Cincinnati Anticline.

"The Bearing of Selection Experiments with Drosophila upon the Frequency of Germinal Changes:" Edwin Carleton MacDowell, Station for Experimental Evolution, Carnegie Institution of Washington. A study of extra bristles indicating that they are primarily occasioned by one germinal unit and that no change of evolutionary or practical significance has occurred during fifty generations.

"Pressure Phenomena accompanying the Growth of Crystals:" Stephen Taber, Department of Geology, University of South Carolina. Many phenomena connected with the metamorphism of rocks, the growth of concretions, and the formation of mineral deposits are difficult to explain under any other hypothesis than that growing crystals have made room for themselves by exerting pressure on the surrounding material.

"A New Method of Transforming Esters of α-Aminoacids into their Corresponding Isothiocyanates:" Treat B. Johnson and Arthur A. Ticknor, Sheffield Scientific School, Yale University.

"The Geology of the Fiji Islands:" Wilbur G. Foye, Department of Geology, Middlebury College, Middlebury, Vermont. It can not be said that the modern reefs of Fiji fully support Darwin's theory.

"Dominance of Linked Factors as a Means of Accounting for Heterosis:" Donald F. Jones, Bussey Institution, Harvard University.

"Chemically Induced Crowngalls:" Erwin F. Smith, United States Department of Agriculture. Small tumors have been produced by the application of various chemicals.

"Dynamical Systems with Two Degrees of Freedom:" George D. Birkhoff, Department of Mathematics, Harvard University.

"National Research Council." Membership of committees. EDWIN BIDWELL WILSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

THE DECIMAL POINT

STUDENTS of the history of science are continually impressed by the fact that we are truly in scientific achievements the heirs of all the ages with progenitors not limited by any bounds of time or place. The historian John Fiske in one of his essays[1] pertinently remarks:

> The thinker who elaborates a new system of philosophy, deeper and more comprehensive than any yet known to mankind, though he may work in solitude, nevertheless does not work alone. The very fact which makes his great scheme of thought a success, and not a failure, is the fact that it puts into definite and coherent shape the ideas which many people are more or less vaguely entertaining, and that it carries to a grand and triumphant conclusion processes of reasoning in which many persons have already begun taking the earlier steps.

The late and lamented Pierre Duhem in that wonderful work, "Le Système du Monde," with the fifth and concluding volume fortunately completed in manuscript before his recent death, opens his work with a statement to the effect that to trace the origin and genesis of great scientific ideas one is gradually led back to the point where history ceases.

The development of decimal fractions furnishes an excellent illustration of the process mentioned. This story was well told in the *Teachers College Bulletin* of 1910 by David Eugene Smith, in an article entitled, "The invention of the demical fraction." I propose in the present paper to discuss briefly one point of the development, namely the appearance of the decimal point itself; I am adding also an early approach to decimal fractions not known to writers on the subject, based upon a study of a Vienna manuscript of the fifteenth century.[2]

[1] "A century of science, and other essays," New York, 1899.

[2] Codex Vindobonensis 4770.

N. L. W. A. Gravelaar, in discussing Napier's works[3] ascribes to Napier priority in the use of the decimal point. In a further article, "De notatie der decimale breuken," Gravelaar[4] purports to show that Napier was not familiar in 1616 and 1617, with the editions of the "Trigonometry" of Pitiscus which appeared in 1608 and 1612, containing the first appearance in print of the decimal point after Stevin's systematic exposition of the subject of decimal fractions in 1585. To me the whole procedure of Gravelaar borders so closely on the absurd that it would not merit discussion, if it had not been accepted somewhat seriously by other writers.[5]

Eneström, the editor of the Bibliotheca Mathematica, refers[6] to Gravelaar's work, as follows: "Nach Herrn Gravelaar ist Neper der erste, bei dem das Komma (Rhabdologia, 1617) und das Pünktchen (Constructio, 1616) als wirkliche Dezimalzeichen vorkommen; Pitiscus hatte zwar schon ein Pünktchen angewendet, aber dies ist nur als ein Scheidezeichen auzusehen." That the point used with decimal significance in Pitiscus is used with full appreciation by Pitiscus should be evident simply from the fact that at this time the work of Stevin on decimal fractions was widely known; further Pitiscus who uses a bar in the text of his "Trigonometry" of 1608 and of 1612, 13/00024 where the point is used in the Tables, explicitly says of 13/00024, "fractione scilicet 24/100000 neglecto," meaning that in place of 13.00024 he uses 13 as an approximation. Among others von Braunmühl, in his "Vorlesungen über Geschichte der Trigonometrie,"[7] mentions the use of the point in decimal fractions by Pitiscus.

The further fact should be noted that the Constructio of 1616 is the English transla-

[3] *Verh. d. Koningl. Akad. v. Wetenschappen,* Amsterdam, 1899, Deel. VI., No. 6.

[4] *Nieuw Archif voor Wiskunde,* Amsterdam, 1900.

[5] Notably by Glaisher and others in the "Napier Tercentenary Volume."

[6] *Bibliotheca Mathematica,* Vol. VI., third series, pp. 108–109.

[7] Vol. I., p. 225.

tion by Wright of Napier's work, and while it did receive examination by Napier before publication, yet the probability is that the innovation of the decimal point was introduced by Wright. To prove even independent development of the decimal point one would have to show that neither Wright nor Napier had the 1608 or 1912 edition of Pitiscus or any knowledge of the work; the earlier edition of Pitiscus is cited by Napier.

Cantor does refer[8] to the use *in manuscript,* as he carefully mentions, of the decimal point by Bürgi "wahrscheinlich kurz nach . . . August 1592"; even of this use in MS. Cantor says[9] "scheint zuerst," whereas of the use by Pitiscus, he says "angeführte Thatsache, dass Pitiscus in Tabellenanhange seiner Trigonometrie von 1608 sowie von 1612 . . . das Decimalstellen abtrennende Pünktchen benutzt hat." My own feeling is that Cantor mentions Bürgi's use of the point in MS. here to strengthen Cantor's similar claim on MS. evidence for priority for Bürgi in the invention of logarithms.[10]

So far as the complete explanation of decimal fractions is concerned that appears in the work of Stevin, "La Disme," of 1585, which work in Flemish and in French evidently attained rapidly wide circulation. In 1603 Johann Beyer in his "Logistica decimalis" gave the explanation of operations with decimal fractions, using a period in combination with Stevin's method of designating the last order of the last place by a superimposed numeral; thus, 8.798^{v} for 8.00798. Even in 1616 Kepler in his "Auszug auss der uralten Messe-Kunst Archimedis" used a comma (reversed) quite as we do a decimal point, and gives a sufficiently complete exposition of the use of decimal fractions.

It seems to me to be distinctly unfortunate that Gravelaar should have given, without any ground as I believe I have shown, credit to Napier for a somewhat important contribution to the theory of notation of decimal fractions; certain writers have been misled into according to Napier honor in this field, where no credit is due.

Except for the fact that a question of nationality is introduced we might say that neither Pitiscus nor Napier is worthy of more than a passing note in the history of the development of decimal fractions. Decimal fractions and a more or less convenient notation for the same were historically inevitable, just as logarithms, the analytic geometry, the graphical representation of complex numbers, the calculus, and many other developments of mathematics were inevitable. The earlier steps leading to these processes can now be traced and it is increasingly evident that a succession of thinkers made possible these attainments. Similarly the preparatory contributions of many minds have made possible the simultaneous discovery, frequently, of apparently new mathematical theories.

In the pamphlet by Professor Smith, which I have cited, there appears the reproduction of a page in Christoff Rudolff's arithmetic of 1526 in which there is the computation of interest at 5 per cent., involving fundamentally decimal fractions, using a bar as a separatrix. Concerning this Enestrom says:[11]

In the year 1492 Francesco Pellizzati (or Pellos) published at Turin an arithmetic in which, in one example, division by 100 of 6976587 is given by 69765.87; the point is also used in dividing by 30, 400, 3000, and the like, pointing off one, two, or three places and afterwards writing the remainder as an ordinary fraction. Pellizzati can, however, not be credited with any real comprehension of decimal fractions. The page in question

[8] "Vorlesungen," Vol. II., second edition, p. 618.

[9] *Loc. cit.*, pp. 617, 619.

[10] See Cajori, "Napier Tercentenary Volume," pp. 101–102.

[11] *Bibliotheca Mathematica,* Vol. X., p. 243, in his article, "Über das angebliche Dezimalbruchzeichen einiger der ältesten gedruckten Rechenbücher."

Hier hat Rudolff wirklich mit Dezimalbrüchen gerechnet; wenn man ferner bemerkt, dass der Strich bei Rudolff gewissermassen ein Komma ist . . . so kann man sagen, dass sowohl die moderne Anwendung wie die moderne Bezeichnung bei Rudolff vorkommt . . . ohne dass Rudolff die Tragweite seines Verfahrens verstanden hat.

is reproduced by Smith in his article, abovementioned, and in the "Rara Arithmetica."

Some time ago in discussing before the American Mathematical Society the "Quadripartitum" of John of Meurs, written about A.D. 1325, I called attention to the fact that this writer also should be included among those who by use of an analogy with the sexagesimal fractions made a near approach to decimal fractions.[12] In the passage in question, which occurs in the twenty-second chapter of the second book, dealing with the extraction of square root, zeros in pairs are annexed to the number whose approximate root is desired. In extracting the square root of 2, six ciphers are annexed to the 2 and the square root of 2000000 is obtained as 1414. At first this is changed to sexagesimal fractions and by successive multiplication of remainders by 60 the root is obtained as 1° (gradus), 24 minutes, 50 seconds, and 24 thirds, or 1 24/60 50/3600 24/216000. The manuscript proceeds, as follows: "Et si vis posses dicere ab inicio cum habuisti hanc radicem 1414 quod unitas que est in quarto loco est sicut integrum et 4 que sunt in tercio loco sunt decima pars integri, et unitas que est in secundo loco est decima decium, et 4 que sunt in primo loco sunt decima decime decime sic 1·4·1·4· Et nota quod istam radicem preinuentam 1414 potes multum bene ponita unitate in loco integrum tres differentias remanentes multiplicare per 10, 20, 30, 40, 50, 60, 70, 80, 90 et semper a producto demptis figuris que excedunt numerum medietatis circulorum, residuas multiplica per illum articulum per quem alias extendisti et hoc facto tociens quod non remaneant nisi tres circuli qui sunt medietas circulorum. Habebis radicem secundum proporcionem integri ad articulum per quem fueris operatus." The statement here that in the 1414 (regarded as the square root of 2, evidently) that the first unit (fourth as counted from the right or ordinary unit's place) is to be regarded as an integer, the following 4 as tenth parts of an integer, the following unit as the tenth part of a tenth, and the final (first, counting in the ordinary way from the right) 4 as tenth parts of the tenth part of one tenth borders closely on the idea of decimal fractions. However, John of Meurs, like so many others who made initial steps in this direction, carried the idea no further.

LOUIS C. KARPINSKI
UNIVERSITY OF MICHIGAN

[12] I am using photographic copies of pages of the Vienna MS. 4770; the passage in question is found on folio 224 verso; the manuscript was probably written in the early part of the fifteenth century, containing also Robert of Chester's translation of the algebra of Al Khowarizmi, recently published in the University of Michigan Humanistic Series.

THE SHORTAGE OF PLATINUM

ACCORDING to a bulletin issued by the U. S. Geological Survey most people are apt to think of platinum as preeminently adapted to settings for precious stones, but the metal is in fact indispensable to many essential industries. Platinum dishes and utensils are absolutely needed in all chemical laboratories, and upon these laboratories all great industries are dependent for guidance. Alloys have been devised for use in the ignition systems of internal-combustion engines, but no substitute for platinum has been found for certain delicate parts of these systems. Platinum and allied rare metals are widely employed in instruments of precision required for making physical tests of materials of all kinds. Probably platinum is now most valuable for its use in the contact process of making concentrated sulphuric acid, which is essential to a great number of industries that are vitally important at all times, and particularly in time of war.

The United States alone annually uses about 165,000 ounces of fine platinum and produces less than 1,000 ounces of crude platinum. Realizing the urgent necessity of increasing the country's production of the metals of the platinum group, the United States Geological Survey, Department of the Interior, has planned an investigation in which L. M. Prindle and J. M. Hill, geologist, will visit places in this country where commercial deposits of these metals may be found.

Native platinum, the metal and sperrylite (platinum arsenide) have been found in basic

igneous rocks at several places in the world but not in commercial quantities. The search for platinum in rocks is therefore not likely to obtain an immediate supply of the metal. Persons searching for platinum ores should remember, however, that the assay for platinum is difficult and apparently can not be successfully made by all commercial assayers. Samples of supposed platiniferous ores should therefore be sent only to the most competent assayers. The United States Geological Survey has received several reports of discoveries of rich platinum ore in which, as the reports state, "the platinum could be detected by the ordinary methods of assay." Such statements should be regarded with great caution, for any platinum ore of commercial grade will doubtless yield traces of platinum if tested by the standard methods employed by competent and reliable assayers.

The platinum supplies of the world, except a relatively small quantity, have been obtained from placer deposits, notably from those of Russia, which have produced about 95 per cent. of the world's output. The largest part of the crude placer platinum now produced in the United States is won by dredges working in California at the west base of the Sierra Nevada, in gravels derived from worn-down lodes and concentrated by natural streams. The greater production from this region than from northwestern California and southwestern Oregon and other places would appear to be due to larger operations rather than to greater or richer deposits.

All the known placer deposits that contain platinum are near areas of basic igneous rocks, and it would seem that the first step in any search for new deposits of platiniferous gravels is to look for outcrops of peridotite, pyroxenite, dunite and serpentine. When areas of these rocks have been found the gravels of the streams that rise in them should be washed to see whether they contain platinum. Most of the heavy concentrates found in gravels that carry platinum are rich in chromite and olivine. The character of the rock of which the gravels were formed may give a clue to their source.

Crude platinum as it occurs in placer concentrates is ordinarily a silvery-white metal, the fresh surface of which could be confused only with that of silver, or possibly with that of iron. It can easily be distinguished from these metals, however, by simple tests, as they are soluble in dilute nitric acid, whereas crude platinum can be dissolved only in concentrated aqua regia, a mixture of three parts of hydrochloric (muriatic) acid and one part of nitric acid. In some placer deposits the grains are coated with a dark film and somewhat resemble the grains of the dark minerals chromite, magnetite or ilmenite, from which, however, they can be separated by careful panning, as the platinum is heavier than any of those minerals.

Platinum will not amalgamate with quicksilver alone, but will amalgamate with quicksilver and sodium. If ordinary quicksilver amalgam is used the flakes of platinum float on the surface and can be removed. If sodium amalgam is used the platinum may be separated from any gold in the amalgam by washing with water until the sodium is converted to sodium hydroxide, when the platinum will come out on the surface, provided the amalgam is sufficiently liquid.

Platinum has a hardness of 4 to 5 and can be scratched with a knife. It is so malleable that it can be hammered into very thin sheets without heating. It is practically infusible, and grains of it can not be melted together, as can particles of gold and lead.

One test for platinum is relatively simple. The metallic particles to be tested are dissolved by boiling in concentrated aqua regia and the resulting solution is allowed to dry. The dry residue is dissolved in hydrochloric acid, and the solution is evaporated by boiling until it becomes a thick mass but is not quite dry. This mass is diluted with distilled water and to it are added a few drops of sulphuric acid and of potassium iodide, which cause it to assume a very characteristic wine-red color if it contains considerable platinum or a reddish-pink color if it contains only a small quantity. This test, though it is fairly delicate, will not

detect traces of platinum if the solution contains large quantities of iron or other elements.

A second test of the residue from the aqua regia solution after it has been dissolved in hydrochloric acid to form the thick mass described is to add to it potassium chloride (KCl), which, if the dissolved residue contains platinum, will precipitate yellow crystals or potassium platinic chloride (K_2PtCl_6).

A third test may be made by adding to the aqua regia solution ammonium chloride (NH_4Cl), which, if the solution contains platinum, will precipitate yellow crystals of ammonium platinic chloride.

The precipitates from the second and third tests are both insoluble in alcohol but are soluble in water and by heating may be reduced to platinum sponge.

The tests described above, though they are comparatively simple and positive if made on single grains, can not be relied upon if the material tested contains other elements than platinum. They should therefore be restricted to grains of a single mineral picked from concentrates obtained by panning a sample of either rock or gravel.

The adequacy of the future supply of platinum in the United States, as far as it can be assured, depends on the results of work of three kinds—first, the determination of our present supply, particularly of unmanufactured platinum metals, in order that it may be mobilized; second, systematic search for new deposits, and third, scientific exploitation of the deposits discovered, to assure their maximum yield. Work of the first two kinds is now being done by the Geological Survey, and it is hoped that work of the third kind—the technologic work—may be in part done by means of federal and private investigations.

A detailed report on the production of platinum in 1916, with information on the world's resources of this metal and hints for prospectors, by J. M. Hill, of the U. S. Geological Survey, is now in preparation and will be ready for distribution in July. Copies of this report may be obtained by addressing the Director, U. S. Geological Survey, Washington, D. C.

SPECIAL ARTICLES

IS THE HOUSE OF TCUHU THE MINOAN LABYRINTH?

WHILE going through a back number of the *American Anthropologist*[1] the writer's attention was attracted by the figure illustrated in Fig. 1. This was in a short paper by Dr. J. Walter Fewkes entitled "A Fictitious Ruin in the Gila Valley, Arizona." In this he showed that this symbol which was first observed by an eighteenth-century Spaniard scratched in the sand by a Pima Indian did not represent the plan of a ruin as previously interpreted, but was used in some way in a game "the house of Tcuhu" (Tcuhiki).

It was curious but this diagram was familiar to the writer and his familiarity came from a distant part of the world. As shown in Fig. 2 this diagram appears on the reverse of a silver coin of Cnossus in Crete of the Greek Period (B.C. 200–67). In this case the figure represents the Minoan Labyrinth. On other coins from Cnossus it sometimes appears in a square form, but even then it has the same ramifications. A comparison of this Greek coin, with House of Tchuhu when inverted, shows that the two are identical in every respect.

There are three possible explanations for the coincidence. First, these symbols may have arisen independently in the new and the old world. Secondly, the symbol may have originated in the old world and have been transported to the new in pre-Columbian times. Thirdly, that the symbol was introduced into America with the Spanish conquest.

On the one hand, it has been pointed out by Fewkes (*loc. cit.*) that the symbol or something like it was early known to the Pima Indians, as the diagram in slightly modified form appears scratched on the adobe wall of the Casa Grande ruin among obviously Indian pictographs. On the other hand, it is possible that this diagram may have had a Spanish origin.

While it is quite generally accepted by American ethnologists that such simple forms

[1] N. S., Vol. IX., 1907, p. 501.

as the cross, the swastika, the wall of Troy, etc., arose in the new world as well as in the old; yet it is hard to believe that such complicated labyrinths similar in every detail could have had separate origins. Similar environments often call forth similar responses in different organisms. In such cases the similarities when carefully analyzed are found to be superficial. The details will not agree. In this case, however, the agreement is exact.

Again there is a possible question that the figure from Fewkes is not of genuine Pima origin. A brief history of this symbol will make this clear. It seems that an unknown Spanish traveler visited the Pima country in the year 1761 or 1762. An account of this visit exists in the form of a manuscript.[2] On

Fig. 1. After Fig. 34, *American Anthropologist*, Vol. IX., 1907, p. 511 (inverted).

Fig. 2. After a Coin from Cnossus in Crete (200–67 B.C.). (Cat. of Greek Coins in British Museum, Vol. 1887, Plate VI., Fig. 5.)

the margin of one of the pages of this manuscript appears the figure which I have reprinted from Fewkes (Fig. 1). According to the unknown Spaniard the Pimas draw the symbol on the sand. He stated that it represents "a house of amusement rather than that of a magnate." As no ruin has ever been discovered with such a ground plan, Dr. Fewkes was led to question an old Pima concerning it.

When Higgins (the name of the Indian) was shown the figure and told the opening lines of the quotation (from the Spanish narrative), the last clause being withheld, he responded that he knew of no ancient house in that region which had a ground plan like that indicated in the figure. He was acquainted with a children's game that employed a similar figure traced in the sand. The Pimas, he said, call the figure *Tcuhuki*, the house of Tcuhu, a cultus hero sometimes identified with Moctezuma.

A search in Russell's work on the Pima Indian[3] and Culin's "Games of the North American Indians"[4] failed to discover a description of such a game. However, Russell did describe a game called *Tculikwikut*, a dart and ring game in which count is kept by means of little stones. These are moved on a diagram made up of a series of small holes in the sand arranged in the form of a whorl arising from a center called *Tcunni Ki* (the council house).

According to Russell *Tcuhu* in the mythology of the Pima is Gopher, who dug the spiral hole through which the Pima clans came up from the underworld. From this it seems possible that both Russell and Fewkes were dealing with the same game. Strength is given to this idea by the fact that Dr. Fewkes showed "Higgins" the diagram and the Indian said that it was the House of Tcuhu. The Indian did not draw the diagram. He may have simply recognized the spiral character of the labyrinth and not have considered the details.

With such fragments of evidence and with so many gaps to be filled it would be premature to draw any conclusion as to how this complicated symbol happens to be found in both the old world and the new. The writer publishes this in hopes that some reader will also be familiar with the symbol and can aid in its interpretation.

Harold Sellers Colton
University of Pennsylvania

2 Rudo Ensayo.

3 Twenty-sixth Ann. Rept. Bur. Eth.

4 Twenty-fourth Ann. Rept. Bur. Eth.

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The first and second year classes are limited to one hundred students, and application for admission should be in the hands of the Dean before July 1st.

REQUIREMENTS FOR ADMISSION: Candidates must have successfully completed the work prescribed for the Freshman and Sophomore Classes in colleges recognized by this University, which must include at least one year of college work in Physics, General Biology or Zoology and Chemistry (Qualitative Analysis is required; Organic Chemistry is recommended, and in 1919 will be required), together with appropriate laboratory exercises in each of these subjects, and either French or German of more than elementary grade. For detailed information send for catalogue.

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POST GRADUATE WORK: (1) Any graduate possessing a baccalaureate degree may pursue work in Anatomy, Physiology, Physiological-Chemistry, Bacteriology, Pathology, Pharmacology, Research Medicine and Mental Diseases with view of obtaining the higher degrees of Master of Arts or Science and of Doctor of Philosophy in the Graduate School of the University. For information address Dean of Graduate School, University of Pennsylvania.

(2) Courses in Public Health (inaugurated in 1906) leading to diploma (Doctor of Public Hygiene, Dr. P.H.), are open to graduates in medicine who have had a preliminary education similar to that required for admission to the Medical School. The subjects comprehended in the course are: Bacteriology, Medical Protozoology and Entomology, Chemistry, Sanitary Engineering, Sanitary Architecture, Meat and Milk Inspection, School Inspection, Vital Statistics, Sanitary Legislation, and Personal and General Hygiene.

The full course extends over one academic year. Special subjects in the course may be taken by any one possessing suitable preliminary qualifications. For details address Director of Laboratory of Hygiene.

(3) From the opening of each term to about February 1 courses in Tropical Medicine are open to graduates in Medicine comprehending instruction in Medical Climatology and Geography, Hygiene of Tropics and of Ships, Tropical Medicine, Bacteriology, Protozoology, Entomology, Helminthology, and General Medical Zoology, Pathology, Skin Diseases, Eye Diseases, and Surgery of Tropical Affections.

(4) During the academic session special courses in any of the branches of the medical curriculum are open to graduates of this or other regular schools of Medicine, both in the clinical subjects and in laboratory studies. The excellent hospital facilities offered by the University Hospital, the neighboring Philadelphia General Hospital and other institutions with which the members of the staff of instruction are connected, guarantee exceptional opportunities for clinical observation.

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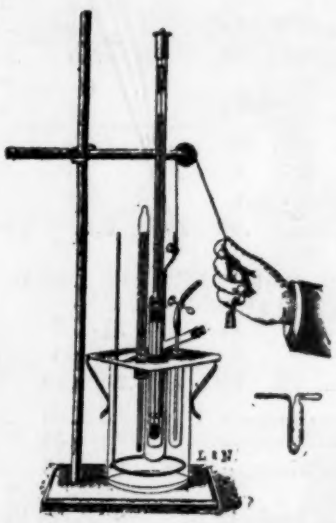

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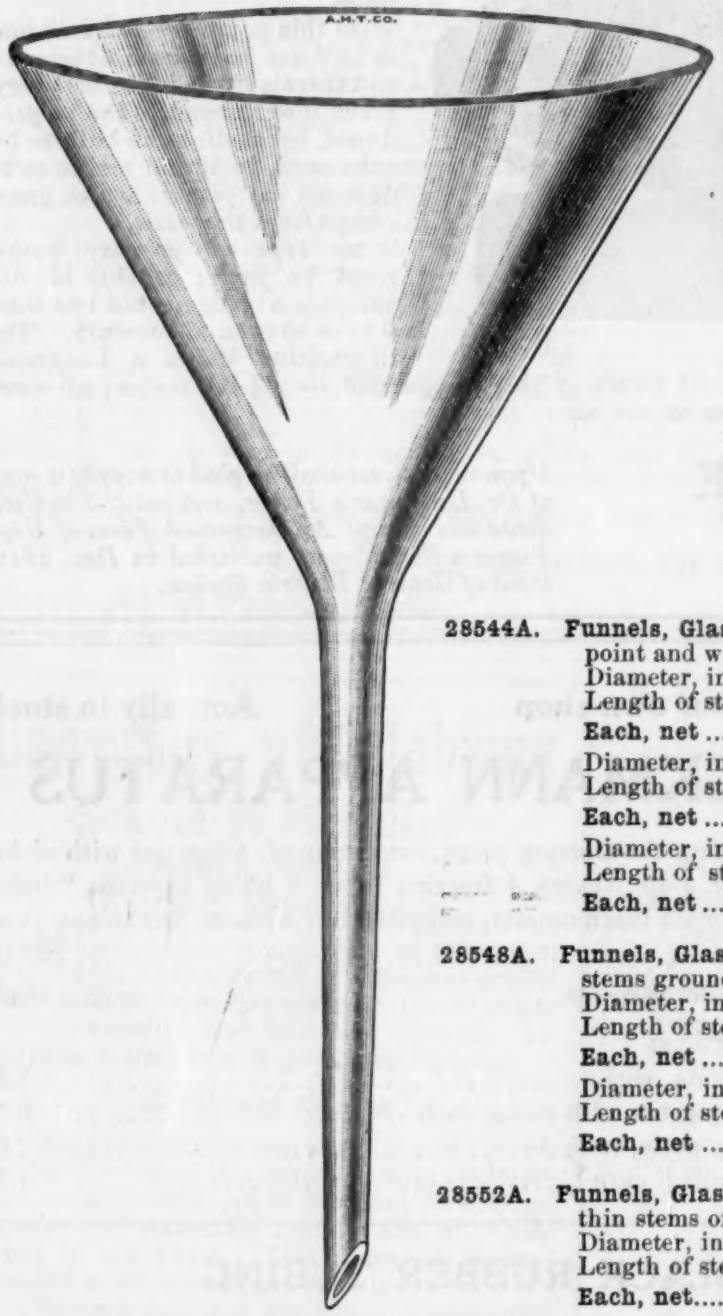

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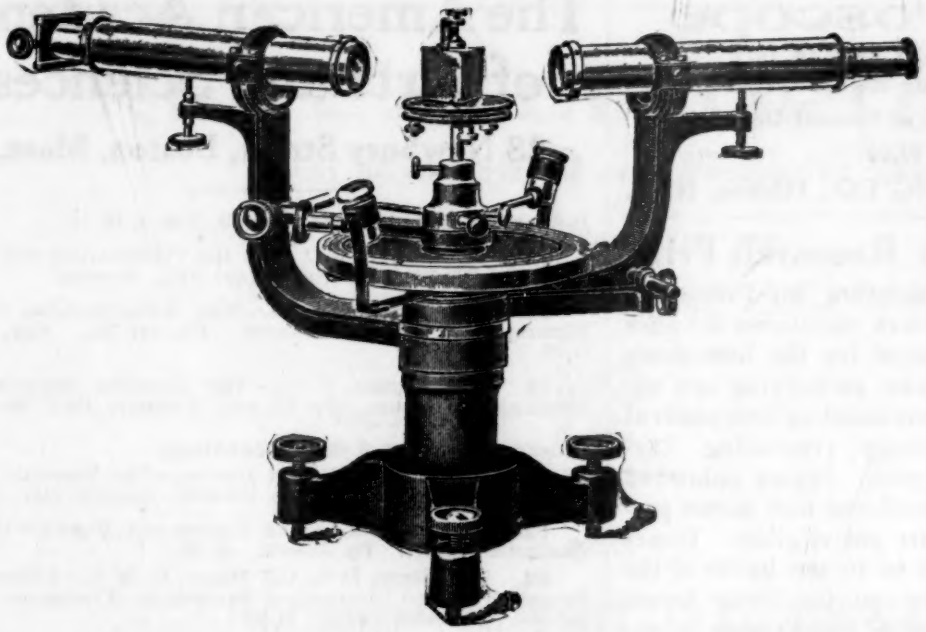

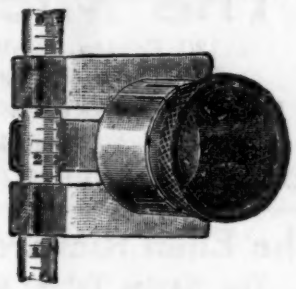

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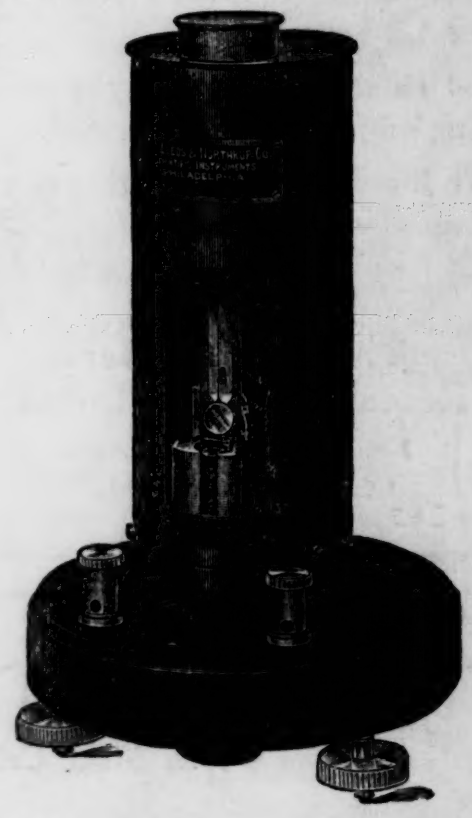

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